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Information technology — Artificial intelligence (AI) — Overview of computational approaches for AI systems

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Abbreviated terms **2**
5 General **3**
6 Main characteristics of AI systems **5**
6.1 General 5
6.2 Typical characteristics of AI systems 6
6.2.1 Adaptable 6
6.2.2 Constructive 6
6.2.3 Coordinated 6
6.2.4 Dynamic 6
6.2.5 Explainable 6
6.2.6 Discriminative or generative 6
6.2.7 Introspective 6
6.2.8 Trained or trainable 7
6.2.9 Accommodating various data 7
6.3 Computational characteristics of AI systems 7
6.3.1 Data-based or knowledge-based 7
6.3.2 Infrastructure-based 7
6.3.3 Algorithm-dependent 8
6.3.4 Multi-step or end-to-end learning-based 9
7 Types of AI computational approaches **9**
7.1 General 9
7.2 Knowledge-driven approaches 10
7.3 Data-driven approaches 10
8 Selected algorithms and approaches used in AI systems **11**
8.1 General 11
8.2 Knowledge engineering and representation 11
8.2.1 General 11
8.2.2 Ontology 12
8.2.3 Knowledge graph 12
8.2.4 Semantic web 14
8.3 Logic and reasoning 14
8.3.1 General 14
8.3.2 Inductive reasoning 15
8.3.3 Deductive inference 15
8.3.4 Hypothetical reasoning 16
8.3.5 Bayesian inference 17
8.4 Machine learning 18
8.4.1 General 18
8.4.2 Decision tree 18
8.4.3 Random forest 19
8.4.4 Linear regression 20
8.4.5 Logistic regression 21
8.4.6 K-nearest neighbour 21
8.4.7 Naïve Bayes 22
8.4.8 Feedforward neural network 22
8.4.9 Recurrent neural network 23

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8.4.10 Long short-term memory network 24
8.4.11 Convolutional neural network 25
8.4.12 Generative adversarial network 26
8.4.13 Transfer learning 27
8.4.14 Bidirectional encoder representations from transformers 27
8.4.15 XLNet 28
8.5 Metaheuristics 29
8.5.1 General 29
8.5.2 Genetic algorithms 29

Bibliography **31**

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Foreword

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Introduction

Artificial intelligence (AI)-related products, systems and solutions have become more common in recent years thanks to rapid software and hardware improvements that boost computational performance, data storage capabilities and network bandwidth. The intent of this document is to look at computational methods and approaches within AI systems. Based on ISO/IEC 22989[1)], ISO/IEC 23053[2)] and ISO/IEC TR 24030, this document provides a description of the characteristics of an AI system and its computational approaches. The illustration of computational approaches in AI systems includes both machine learning and non-machine learning methods. To reflect state-of-the-art methods used in AI, this document is structured as follows:

— Clause 5 provides an overall description of computational approaches in AI systems;

— Clause 6 discusses the main characteristics of AI systems;

— Clause 7 provides a general taxonomy of computational approaches, including knowledge-driven and data-driven approaches;

— Clause 8 discusses selected algorithms used in AI systems, including basic theories and techniques, main characteristics and typical applications.

By giving an overview of different technologies used by AI systems, this document is intended to help users understand computational characteristics and approaches used in AI.

1) Under preparation. Stage at the time of publication: ISO/IEC DIS 22989:2021.

2) Under preparation. Stage at the time of publication: ISO/IEC DIS 23053:2021.

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Information technology — Artificial intelligence (AI) — Overview of computational approaches for AI systems

1 Scope

This document provides an overview of the state of the art of computational approaches for AI systems, by describing: a) main computational characteristics of AI systems; b) main algorithms and approaches used in AI systems, referencing use cases contained in ISO/IEC TR 24030.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 22989, *Information technology — Artificial intelligence — Artificial intelligence concepts and terminology*

ISO/IEC 23053, *Framework for artificial intelligence (AI) systems using machine learning (ML)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 22989 and ISO/IEC 23053 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
heuristic search
search, based on experience and judgment, used to obtain acceptable results without guarantee of success

[SOURCE: ISO/IEC 2382:2015, 2123854, modified — Notes to entry removed.]

3.2
fuzzy logic
fuzzy-set logic
nonclassical logic in which facts, inference rules and quantifiers are given certainty factors

[SOURCE: ISO/IEC 2382:2015, 2123795, modified — Notes to entry removed.]

3.3
generator
neural network that produces samples usually to be classified by a discriminator

Note 1 to entry: Generators primarily appear in the context of generative adversarial networks.

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3.4
discriminator
neural network that classifies samples usually produced by a generator

Note 1 to entry: Discriminators primarily appear in the context of generative adversarial networks.

3.5
generative adversarial network
GAN
neural network architecture comprised of one or more generators and one or more discriminators that compete to improve model performance

3.6
platform
combination of an operating system and hardware that makes up the operating environment in which a program runs

[SOURCE: ISO/IEC/IEEE 26513:2017, 3.30]

3.7
perceptron
neural network consisting of one artificial neuron, with a binary or continuous output value that is determined by applying a monotonic function to a linear combination of the input values and with error-correction learning

Note 1 to entry: The perceptron forms two decision regions separated by a hyperplane.

Note 2 to entry: For binary input values, the perceptron cannot implement the non-equivalence operation (EXCLUSIVE OR, XOR).

[SOURCE: ISO/IEC 2382:2015, 2120656, modified — term revised, “or continuous” added to definition and Notes 3 and 4 to entry removed.]

4 Abbreviated terms

AI	artificial intelligence
ASIC	application-specific integrated circuit
BERT	bidirectional encoder representations from transformers
BPTT	back propagation through time
CNN	convolutional neural network
CPU	central processing unit
DAG	directed acyclic graph
DNN	deep neural network
ERM	empirical risk minimization
FFNN	feedforward neural network
FPGA	field programmable gate array
GDM	gradient descent method
GPU	graphics processing unit

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